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ABSTRACT

A 1994 meeting to discuss current stresses on the university research system brought together faculty and administrators from 13 research institutions, federal research-sponsoring agencies, members of Congress, and interested professional association and philanthropic foundation representatives. Participants acknowledged that the system of academic research in the United State is increasingly troubled and suggested the reason is that the compact between the federal government and research universities articulated half a century ago by Vannevar Bush has eroded. From a once-elite dialogue between a limited number of scientists and government policy makers, the research enterprise has moved into a period of broader popular scrutiny and heightened expectations, and the public and its elected officials feel that they have a stake in the academic process. These changes suggest a need for fundamental policy changes. Discussion at the conference focused on six major policy issues: (1) creating and communicating priorities in research and education; (2) balancing research and education activities; (3) facilitating multi-disciplinary research and education; (4) identifying patterns of institutional support for research; (5) restoring a sense of community on campus; and (6) developing relationships with new partners in research. The report includes summaries of the discussions of each of these issues and suggestions for action and change. (JB)

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Stresses on Research and Education at Colleges and Universities: Institutional and Sponsoring Agency Responses

Report of a Collaborative Inquiry Conducted Jointly by the National Science Board and the Government-University-Industry Research Roundtable

July 1994

The purpose of this report is to contribute to discussions of the choices facing the U.S. academic enterprise as we approach the twenty-first century. The views expressed in this report are those of the study participants and do not represent official policy statements of the National Science Board or of the Government-University-Industry Research Roundtable and its sponsoring organizations, the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

GOVERNMENT-UNIVERSITY-INDUSTRY
RESEARCH ROUNDTABLE

2101 Constitution Avenue, N.W.
Washington, D.C. 20418

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COCHAIRMEN'S STATEMENT

The U.S. system of academic research and graduate education has set world standards for excellence and achievement. It has drawn a growing number of students from other countries and turned out successive generations of highly trained graduates. It has produced an outpouring of discoveries and new knowledge that have enriched our understanding and appreciation of the universe; aided our attack on environmental, health, and social concerns; and launched entirely new industries.

Today many changes are occurring in our institutions of higher education and research, as an array of new opportunities and collaborative research arrangements emerge, as the focus of federal attention shifts from defense to domestic needs, and as international cooperation and competition intensify. During the past two decades, the university system has grown and proliferated. More institutions have aspired to become research universities. Traditional fields of research have generated new disciplines and spheres of knowledge. Groups and centers have increased in number, relative to individual research projects, and the allegiance of researchers has shifted increasingly from their home campuses to outside sponsors and to disciplinary and professional organizations. Research is less tightly bound to graduate education than it once was, and in some instances, it has become a separate enterprise staffed by non-tenure track employees.

Concurrent with these changes in the university research enterprise, many other aspects of the academic system are undergoing revision of purpose, organization, and financial support, and an increasingly diverse array of constituents is demanding satisfaction for their investment in the nation's colleges and universities. The demography of the student population is changing, and the ability of many students to pay tuition has decreased as the costs of education have gone up. Federal and state support of higher education is increasingly constrained, requiring institutions to pursue bold new approaches to obtaining funding. The public is demanding more accountability for its investment in teaching and research, and administrative and regulatory requirements have exploded in areas of cost accounting, cost sharing, conflict of interest, intellectual property rights, and employment and procurement procedures.

As a result of these many changes, individual institutions and their faculties are being asked to do more: to respond to the vocational needs of a work force that requires ever more advanced skills; to accommodate the needs and expectations of an increasingly diverse faculty and student population; to emphasize research of clear economic relevance to the nation; and to collaborate with industry while ensuring the objectivity and the integrity of research. Not surprisingly, the proliferation of new demands and changing expectations have provoked a host of financial and administrative stresses that are felt at every level of the academic system. The study described in this report attempts to identify the most potent sources of stress and dissatisfaction within campus communities, and to suggest potential remedies that institutions and federal agencies that sponsor research might pursue.

Our major conclusion from this investigation is that the system of academic research in the United States is becoming increasingly troubled, as evidenced by the unhappiness of the research community, on the one hand, and of politicians, policy makers, and the broader community of citizens, on the other. Academic researchers express frustration about the impediments to research and

Educational experiments often take place on a single campus. They are rarely studied or evaluated by other colleges or universities that stand to profit from knowing about them. Inter-institutional cooperation in educational experimentation ought to become more common. It is possible for a group of institutions to plan specific educational reforms jointly, to try out variants of these on individual campuses, to monitor these experiments, and to learn from them. These experiments would then be the common concern of all the institutions involved. Each would have invested funds and manpower resources. Each would have an interest in incorporating into its own programs the results achieved.

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From "The Assembly on University Goals and Governance," Daedalus, 104(1), Winter 1975 (reprinted in Daedalus, 122(4), Fall 1993).

teaching, and about the mixed messages coming from their federal patrons and a once-appreciative public. Federal officials, in turn, suggest that the stress experienced by university scientists results from rapid and radical changes occurring in society, more broadly, and that the solution may require fundamental changes in the way colleges and universities do business.

The heart of the many problems facing the academic system, we believe, is that different constituencies with stakes in the enterprise have diversified and drifted apart in purpose, without adequate means for communicating and for resolving their differences. A variety of symptoms suggests trouble in the nation's system of academic research:

- a lack of appreciation by the public generally of the role of academic research within the mission of the university;
- a lack of communication between those who do academic research and those who support them, both at the federal level and within their home institutions;
- a loss of institutional integrity, as academic research and those who perform it become increasingly removed from the other missions of the university;
- a growing divergence between the demands imposed by changing life-styles, opportunities, and modes of research, and the demands of the academic community on new faculty researchers; and
- an erosion of the sense of partnership between the federal government and research universities.

Results of this drift and discord include a weakening of public support for university research and increasing confusion regarding public expectations of faculty investigators. Additionally, the failure of communication between those at all levels of the research system—between individual investigators and campus administrators, between the practitioners and policy makers of science, and between these stewards of the scientific enterprise and the public—has led to misunderstandings and to significant mistrust among the primary stakeholders in the academic enterprise. Together, these forces have contributed to the growing burden imposed on investigators and administrators at colleges and universities by the increasing array of regulatory requirements accompanying the award and oversight of federal research support. The loss of support and trust, too, has hampered consensus building regarding the goals and objectives of a national science policy.

The elements necessary for an effective remedy to these problems are many and include the following:

- new, broadly based strategic thinking and planning within federal agencies and at research universities, and communication of the results of those efforts to all stakeholders in the academic enterprise;
- improved methods of forming alliances and partnerships between university researchers and external or interdepartmental partners, and new approaches to generating the initial investment needed to establish them;
- modes of external support that renew the institutional strength and integrity of our research universities, rather than undermine them;
- further administrative simplification within and among federal agencies and at research universities in order to increase the time available for researchers to participate in the university community;
- greater flexibility at the departmental and institutional levels with respect to the tenure system, and greater incentives for mentoring and undergraduate teaching by senior faculty; and
- at the national level, a new vision that integrates the diverging interests of the stakeholders in the academic system.

The most basic message emanating from this investigation is that the compact between the federal government and the research universities articulated half a century ago by Vannevar Bush has eroded and that major changes in the academic system may be timely. From a once-elite dialogue between a limited number of scientists and government policy makers, the research enterprise has moved into a period of broader popular scrutiny and heightened expectations, and the public and its elected officials feel that they have a stake in the academic process. As the voices in this debate have multiplied, the constituencies themselves have not coalesced around a common set of principles and objectives, but rather have drifted apart in their purposes. The need to reconsider the fundamental assumptions of the nation's science policy, therefore, and to identify the role of colleges and universities within a coherent vision of the scientific enterprise, has become urgent. Faced with increasing indications that major aspects of the university research system are ripe for reconstruction, we believe it is in the interest of all members of the academic community to take the lead and to speed this period of reform.

Richard F. Celeste
Roland W. Schmitt

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PROJECT REPORT

Here is the reality, plain and simple. Our ivory tower is under siege. People are questioning our mission and questioning who we are. They claim we cost too much, spend carelessly, teach poorly, plan myopically, and when we are questioned, we act defensively.

Thomas H. Kean
President, Drew University

The U.S. system of university research and education has long been the standard of the world. In the decades since World War II, our academic system has been preeminent both in its scope and its depth, and unmatched in the quality of its output and the creativity and productivity of its personnel. At the same time, the system has expanded greatly to meet a growing demand, as postsecondary education has become essential to success in the work force.

Today, this remarkable system is troubled. Despite its success, and the rapid growth in support of research during the 1980s, members of the academic community are experiencing significant stress and dissatisfaction. A number of earlier studies have dramatized this fact, illuminating certain broad, systemic trends affecting the academic enterprise and offering potential responses to the growing discontent within the university community.[1] These studies have approached the subject from a national and system-wide perspective. The project described in this report complements these earlier, national studies by focusing attention at the level of the individual institution.

In the spring of 1993, the National Science Board (NSB) and the Government-University-Industry Research Roundtable (the Research Roundtable) invited a number of academic institutions to participate in an examination of the stresses on research and education at colleges and universities. At the heart of the study was a simple question: Why has the level of stress and dissatisfaction on academic research campuses intensified dramatically during a period of real growth in financial support? In order to gain answers to this apparent enigma, this investigation used a campus-based, bottom-up approach, soliciting insights from faculty and administrators at 13 academic institutions.[2] The participating institutions were selected to represent a range of research-intensive colleges and universities, including institutions of varying size, geographical location, public or private control, historically black campuses, and liberal arts colleges with strong science and engineering programs.

In the first phase of the study, faculty members and administrators met on their respective campuses to discuss how academic institutions with significant research activity and research-sponsoring agencies should respond to the most troubling issues facing the academic research and education enterprise. The second phase of the project was a two-day conference in Washington entitled "The Stresses on Research and Education at Colleges and Universities: Institutional and Sponsoring Agency Responses." This national summary meeting capped the ten-month inquiry and provided an opportunity for academic participants to exchange views with representatives of federal agencies, state governments, Congress, and other interested parties.

The national symposium held in Washington was cochaired by Richard Celeste, chairman of the Research Roundtable, and Roland Schmitt, past member and chairman of the NSB and president emeritus of Rensselaer Polytechnic Institute. More than 100 individuals participated in the conference, representing a cross-section of university and sponsoring agency administrators, working scientists and engineers from colleges and universities, representatives of professional societies and philanthropic foundations, federal and state officials, and congressional staff.[3] On the first day, representatives of the academic institutions forged consensus on a specific set of stresses and related options for remedial action. On the second day of the meeting, federal officials had an opportunity to respond to the recommendations of the universities and to articulate their concerns about the research and educational endeavors of American colleges and universities.

In his introductory comments at the meeting with university representatives, Chairman Celeste challenged

[1] A set of reports describing these problems and their etiology served as the starting point for discussions at each of the campuses that participated in the present inquiry. Those reports include several by the Government-University-Industry Research Roundtable (1989, 1992), one by the President's Council of Advisors on Science and Technology (1992), and one by the Federal Coordinating Council on Science, Engineering, and Technology (1992). The Bibliography to this report includes a complete listing of the seven publications distributed to all academic participants in this project.

[2] The 13 institutions that participated in this project are identified at the end of this report.

[3] The agenda of the conference is reproduced at the end of this report.

the group to work to renew the partnership that has existed between the nation's great academic institutions and the federal government since the close of the Second World War. He urged participants to identify the most troubling issues confronting the academic research enterprise and to propose possible responses to them. He instructed the participants, also, to avoid recommending increased funding as the primary remedy for the difficulties they identified. Celeste challenged these participants, instead, to devise a set of suggestions to enhance the academic system without spending vast, new sums of money.

In his welcoming remarks, Dr. Schmitt articulated the enigma of plummeting morale in the face of increasing financial support and drew attention to major trends affecting the academic research system. First, there has been a strong shift in the relative magnitude of financial support for universities from various sources, with decreases in federal contributions relative to both industrial and institutional investments. Second, there has been significant growth in the number of schools participating in the research enterprise, creating an academic milieu dramatically different from the time when most research was conducted at a small group of elite institutions. According to Schmitt, these trends may signal a shift or a diversification of expectations for the academic enterprise, creating an uncertain system of incentives and rewards for those in the university community.

Discussion during the national summary meeting revealed dissatisfaction among virtually every party to this enterprise, including the public, politicians, and scientists alike. The breadth and depth of their dissatisfaction underscore the urgency of constructing a new, shared vision of the role of research and education in achieving national goals, and of clarifying the mission of universities as the stewards of these activities. The nature of this most compelling concern—the need to reassess the compact among the primary stakeholders in the academic enterprise—is explored in the final section of this report.

MAJOR POLICY ISSUES AND RELATED ACTION ITEMS

The two days of deliberations among academic and federal agency participants revealed a wide array of stresses affecting the university community. At the final session, presentations by university representatives were structured according to six broad issue areas: (1) creating and communicating priorities in research and education; (2) establishing the proper balance between research and education activities; (3) facilitating multidisciplinary research and teaching; (4) restructuring patterns of institutional support for research; (5) rebuilding a sense of community on campus; and (6) clarifying opportunities for new partnerships in research. The following sections summarize comments pertaining to these six issues and enumerate the primary responses to each that were suggested by participants.

I. Creating and Communicating Priorities in Research and Education

The visions and goals of the academic enterprise need to be expressed in strategic thinking and in strategic planning within the federal establishment and on research campuses. According to participants in the national summary meeting, consensus regarding the goals and objectives of a national science policy is lacking.[4] The lack of consensus has resulted in misunderstanding, misinformation, and distrust among representatives of government, universities, and the public. Some participants asserted,

As a first priority, institutions must establish a formal strategic planning process to adapt to the changes in the funding environment.

for example, that federal agencies seem to have only sporadic and poorly defined planning processes. Others noted that although critics of universities call for the institutions to do a better job of setting priorities, the agencies themselves do not do so, spreading resources too thinly and changing priorities too often. Frequent shifts in federal programs jeopardize the large investment required to prepare proposals and prove the feasibility of a research approach. Government policy makers, too, expressed disappointment and frustration with a perceived lack of strategic planning on college campuses.

To identify organizing principles and build a common understanding of the nation's objectives for science and research, it will be necessary first to acknowledge the interests of the full array of stakeholders in this enterprise. These stakeholders have differing expectations of colleges and universities: the public, for example, may consider

[4] This concern, articulated by many participants in the national summary meeting, may be addressed by the imminent release of a white paper on science policy by the President's Office of Science and Technology Policy.

There is a lack of awareness, even within university communities, of the extent to which research and education activities are interdependent. It is often assumed that these endeavors are evolving into mutually exclusive activities.

undergraduate education relevant to the workplace to be the most valuable service of the university, whereas politicians may view academic institutions as tools for economic development. Scientists and industry leaders, too, have different expectations regarding the products of academic research and student training.

All of these stakeholders should be engaged in continuing discussions to clarify the objectives of a national science policy. The participants in this project agreed that in order to revive a sense of partnership and trust among government and universities and, eventually, to reformulate a program for the nation's science agenda, new forums must be created to reconcile priorities identified by each partner in this enterprise. This will demand more effective linkages between strategic planning and policy committees at the national, state, and institutional levels. It will also require better communication with the public, as well as with other customers of research, education, and university services, in language that is meaningful to each constituency.

Optional Responses for Academic Institutions[5]

- Establish a forum for strategic discussions—including representatives of both the faculty and the administration—for the dual purpose of determining research priorities and improving research-related communications on campus.
- Give serious and specific consideration to the recommendation of the 1992 report of the President's Council of Advisers on Science and Technology that universities eliminate or down-size some departments and specialties, rather than sustain less than world class activities in every area of science and engineering.
- Collaborate with federal agencies, industry leaders, and other stakeholders to develop a consensus regarding the nation's goals for research and development. Establish new forums to reconcile bottom-up and top-down priorities.

Optional Responses for Government Agencies

- Institute a well-understood process for setting priorities at each sponsoring agency.
- Develop the new system of government-wide strategies and trade-offs implicit in the new National Science and Technology Council structure. Ensure that the activities of this council incorporate adequate input both from academia and from industry, and that effective mechanisms of communication are in place during both the formulation of plans and the dissemination of results.
- Strive for a reasonable balance between stable funding for productive research and the initiation of promising new areas. Policies that govern this balance should be articulated and understood by the academic research community so that its members can respond appropriately.

Optional Joint Initiative

- Establish an annual forum to address issues of policy, strategy, and priorities that are cooperatively formulated and commonly understood.

II. Balancing Research and Education Activities

Recently, critics have charged that many university professors spend too much time in research endeavors, neglecting their roles and responsibilities as teachers and mentors. Participants in this forum emphasized that graduate training cannot be separated from research experience and that there is a clear need to communicate this connection more effectively to the public. There is also a need, however, to improve undergraduate training in all of the sciences. In the words of one official, "We have not done a good job of measuring quality in education, and there is a need to examine what we are trying to accomplish, and how well we are doing." Participants agreed, too, that research experience enriches and strengthens undergraduate education, and that integrating these two missions should be an objective of both academic institutions and federal agencies.

A number of participants asserted that our system of higher education has been eminently successful, pointing

[5] Our brief review of each major issue cannot capture the richness of the discussions that transpired on individual campuses and throughout the summary meeting. We have, therefore, collected highlights of the many suggestions put forth by participants.

out that enrollments continue to climb nationwide and that foreign students flock to our graduate schools. Virtually all participants agreed, however, that current reward systems on most campuses emphasize research more than excellence in instruction. Federal programs and policies, too, have contributed to the prevailing culture that draws faculty away from teaching. Federal actions have a system-wide effect on institutions, and too often, agency actions regarding research programs have unintended and detrimental effects on other university activities, drawing resources away from non-research intensive departments or affecting the teaching work load of various elements of the university community.

Optional Responses for Academic Institutions

- Reaffirm academicians' roles both as researchers and as teaching professors through appropriate changes in the promotion and tenure processes.
- Devise teaching and professional development programs for faculty designed to improve undergraduate instruction and mentoring, and implement quality improvements and methods of evaluating student counseling, communications, and the integration of teaching and research.
- Encourage and support efforts to incorporate new information and technologies into existing courses and to develop new courses.

Optional Responses for Government Agencies

- Recognize the multiple roles of universities in society by clarifying expectations and by supporting rewards for faculty engaged in undergraduate education as well as in research.
- Consider how research funding will affect undergraduate educational programs and the undergraduate research infrastructure. Make AREA (Academic Research Enhancement Award) grants at the National Institutes of Health (NIH) renewable, like the RUI (Research at Undergraduate Institutions) grants of the National Science Foundation (NSF), and develop similar programs at all funding agencies.
- Continue to provide funds for undergraduate laboratory improvement and supplemental awards for training undergraduate students, particularly those from underrepresented groups. Make work study awards available to institutions for the purpose of involving students in faculty projects that are not yet federally funded.
- Modify the pace and schedule of the research proposal and reporting process to make each more compatible with the demands of educational programs.
- Increase interagency efforts to improve teaching and to develop innovative course materials in the teaching of science.

III. Facilitating Multidisciplinary Research and Education

Many of the most compelling and significant problems of science today are interdisciplinary in nature. Virtually all of the academic participants agreed on the value of multidisciplinary research for graduate education, although some questioned the wisdom of undergraduate multidisciplinary degree programs. Skeptics of such undergraduate programs emphasized the importance of rigorous grounding in fundamental disciplines of knowledge.

Despite consensus that much exciting and important research is done at the interface of traditional disciplines or departments, there are many barriers to effective multidisciplinary research and teaching in all components of the system—both within federal agencies, as they offer research support, and within universities, whose structures and reward systems fail to facilitate this type of collaboration. There are two types of barriers to collaboration across scientific domains: those related to personal careers and academic culture, and those that are administrative in nature. Within academic institutions, for example, the nature of tenure and promotion discourages multidisciplinary work, reinforcing instead single-authored research and publications conducted within traditional disciplinary boundaries. Collaborative team teaching, too, is discouraged by fiscal systems that promote competition between budgetary units for fixed resources. At the federal level, rigid indirect cost recovery

Interdisciplinary programs are 'orphans' within the fiscal bureaucracy of the university. These programs are at a further disadvantage since most of the university's planning efforts are based on the fiscal structure. Thus, interdisciplinary programs play a less prominent role in the long-range planning of the university.

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rules and regulations pertaining to the carryover and allocation of costs by scientists with multiple awards impede collaboration with colleagues in other departments. Peer review panels, too, often lack the breadth of expertise to evaluate multidisciplinary proposals adequately.

In order to reduce barriers to multidisciplinary research and teaching, universities could demonstrate the value of collaborative activities by rewarding such activities in the promotion and tenure process, and by giving multidisciplinary programs identity within the fiscal and administrative structure of the university. Federal agencies, too, could reward multidisciplinary efforts by increasing the priority accorded to applications that feature them, by increasing multidisciplinary representation on peer review panels, and by increasing collaboration across agencies.

Optional Responses for Academic Institutions

- Institute financial inducements to do multidisciplinary research, and remove financial penalties or other barriers imposed by the department and budgetary center structure, including current formulas for tuition distribution, the handling of indirect cost recovery among collaborators, and the present system of recruiting graduate students.
- Initiate a dialogue with scientific societies and other professional groups to promote recognition for multidisciplinary work.

Optional Responses for Government Agencies

- Emulate the NIH mechanism that recognizes multidisciplinary research in training grants.
- Strengthen multidisciplinary programs within agencies, and ensure that practice at the level of the program officer is consistent with expressed agency policies on multidisciplinary research.
- Introduce greater use of preproposals in order to reduce some of the extra costs associated with multidisciplinary research proposals.

IV. Identifying Patterns of Institutional Support for Research

Despite the absolute increase in the federal government's investment in university research, financial pressures on individual institutions and on investigators are growing. As the size of the academic research enterprise has increased, with respect to both the number of researchers and the number of research universities, competition for external funding has grown. Increasingly, institutions devote their own resources to the support of research, the costs of which are not fully covered by external sponsors. The cost sharing that results has a measurable impact on other university missions, reducing funds available for activities other than research. Simultaneously, the costs of research continue to rise in many fields, as cutting-edge investigations rely increasingly on advanced scientific instrumentation and cross-disciplinary teams, and as facilities become more expensive. In this funding environment, individual scientists and research teams feel growing pressure to have multiple grant proposals at some stage of development or review.

These demands on research faculty detract from the time available for the conduct of research and for other faculty obligations, especially undergraduate teaching and mentoring. The resulting pressure is especially great on young investigators who struggle to establish credentials as researchers while meeting obligations for teaching and other requirements for obtaining tenure. Senior scientists, in turn, express concern that temporary disruptions in funding imperil valuable research capability and have detrimental effects on the many graduate students, postdoctoral fellows, and technicians who depend on their laboratories for financial and scholarly support.

Demands for further institutional cost-sharing with federal research funding agencies have reached the point where they have not only exhausted the limited flexible resources of most schools, but are raising serious issues of policy and principle. Which of the nonfederal funds should we tap for further cost-sharing on research projects?

Virtually all of the participants in this inquiry concurred that there is a need to undertake a comprehensive effort to standardize and streamline the grant application, oversight, and compliance processes across agencies. Simplifying and making uniform procedures for awarding and for overseeing research support would yield significant benefits in cost savings and efficiency while simultaneously freeing up time and resources for other academic

duties. This objective is consistent with Vice President Gore's National Performance Review, which was designed to make government work better and cost less by streamlining federal procedures and bureaucracies. Several participants noted that the Federal Demonstration Project—an ongoing, collaborative effort involving more than 50 research universities and institutions, and 10 federal agencies—is designed to improve the management of federally funded research by eliminating unnecessary administrative procedures and streamlining those required to ensure accountability.[6] Others pointed out that an interagency effort involving the NSF, the NIH, and the Department of Defense, is now under way to develop common data submission forms and electronic applications.

All of the participants in the national meeting urged that the competitive grant system, with awards based on merit review by peers, be preserved in any efforts to advance administrative simplification and efficiency. Those representing colleges and universities also underscored the value of maintaining the diversity of research and educational institutions that exists across the country, which include public and private schools, land grant colleges, historically black colleges and universities, and liberal arts colleges. These schools represent different student populations and different sets of institutional priorities and pressures. For this reason, a diversity of federal programs is essential to support research that capitalizes on the contributions to the nation offered by these institutions.

Optional Responses for Academic Institutions

- Provide bridge funds to ensure continuity of progress in research laboratories and in related educational programs during "off" cycles or unsuccessful renewals.
- Require only the five best papers as documentation of research effort in the tenure process, and otherwise reestablish promotion and tenure policies to reflect an emphasis on quality rather than quantity.
- Find new ways to support the shops and service centers on campuses, perhaps through the use of endowed funds.

Optional Responses for Government Agencies

- Expand grants to young investigators, and maintain a five-year commitment for First Awards.
- Offer relatively small ($10,000–20,000 per year) starter grants programs to both new and more senior faculty to enable them to explore new directions or undertake new lines of research; these should have modest application requirements and rapid review procedures.
- Establish a financial accreditation process that would reduce the administrative burden of the audit function, for example, by allowing the government to review an institution's financial/research infrastructure periodically rather than auditing individual awards.
- Set aside some portion of research appropriations for "bridge" awards (modeled after the Shannon Grants at the NIH) or other buffer mechanisms to ensure continuity of progress in research laboratories and related educational endeavors that involve historically well funded programs during temporary lapses in support.
- Where appropriate, institute a streamlined preproposal or two-stage process to make preliminary judgments about the probability of funding proposals, reserving requirements for detailed budgets, compliance forms, and assurances until after a decision has been made to fund a project.
- Provide an academic infrastructure fund at the federal level from which competitive grant awards can be made, particularly for modernization, renovation, and upgrading of facilities.
- Improve the effectiveness and efficiency of available support through multiyear funding.
- Reduce state regulation and reporting requirements, allowing greater flexibility in the administration of research funds.

The existing tenure, funding, and reward systems all encourage faculty to take an entrepreneurial approach to research, which sometimes conflicts with a sense of community and shared fate. Also, the relative lack of women and minority faculty contribute to a special sense of isolation in these groups.

[6] Government-University-Industry Research Roundtable, *What is the Federal Demonstration Project?* Washington, D.C., revised 1994. Also see Office of the Vice President, *National Science Foundation and Office of Science and Technology Policy: Accompanying Report of the National Performance Review*, Washington, D.C., September 1993.

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V. Restoring a Sense of Community on Campus

Institutional effectiveness and the integrity of the academic enterprise depend on shared values and on a mutual sense of priorities and mission—in other words, they depend on a sense of community. Discussions among the academic participants suggested that social change and the growing diversity of faculty and student populations require adjustments in campus policies that are sometimes slow to be recognized. They indicated also that inadequate communication among various elements of the university, combined with an increasing orientation toward external research sponsors and professional organizations, has come at the expense of campus loyalty. As investigators struggle to obtain support for research, many develop an overriding allegiance to their field of science, their research sponsors, and their own academic advancement. Together, these factors have undermined the sense of community on many campuses. According to one commentator, the loss of institutional loyalty and the deterioration of a sense of common values and objectives have transformed many universities into "holding companies for entrepreneurs."

Suggested approaches to rebuilding a feeling of community on campus include efforts to reduce red tape, to foster trust, and to accommodate diverse styles of participation in research and other campus activities. Just as they called on federal agencies to streamline and standardize the administration of research awards in order to allow faculty more time for undergraduate teaching, so the university participants proposed that reducing complex regulatory and accounting requirements would make time for other activities, including mentoring young faculty and nurturing the needs of an increasingly diverse student and faculty population. Similarly, efforts to eradicate barriers to multidisciplinary research and teaching at both the institutional and the federal levels would enable faculty members to develop more extensive ties across the campus. Each of these approaches would enhance individuals' feeling of ownership and inclusion in institutional affairs, and so renew a sense of community. More effective communication among investigators, university administrators, and federal agency officials also would revive a sense of trust among all of the stakeholders in the academic enterprise, including practitioners, patrons, and consumers of research and education.

A major area of concern is the increasing emphasis by government and universities on building linkages with industry. Concomitantly, the public as well as the same government and universities are calling for well defined guidelines to prevent conflicts of interest.

Optional Responses for Academic Institutions

- Make mentoring of junior faculty—especially members of historically underrepresented groups—an important part of the review of senior faculty; provide new faculty with better training in the grants process, in course management and teaching, in general research program management, and in mentoring graduate students.
- Systematically promote meaningful exchanges between faculty and administrators, perhaps through the mechanism of "town meetings" or retreats, to establish center, departmental, or university goals; increase the commitment of administrators to these meetings.
- Ensure that new assistant professors—especially those from underrepresented groups, whose experience and perspectives may be in special demand—are not exposed to excessive administrative or committee responsibilities.
- Establish policies pertaining to quality-of-life issues that affect the personal and professional well-being of faculty members, including family leave, child care, off-campus leave, and modifications of the "tenure clock" for young scientists who are parents.
- Establish and communicate clearly the criteria used in tenure and promotion decisions, and provide yearly evaluations of progress toward those goals to individual scientists.

Optional Responses for Government Agencies

- Make mentoring of young faculty an expected component in renewal of federal funding.
- Provide institutions with funding to distribute in the form of small pilot study grants, especially for young faculty and faculty from underrepresented populations.
- Revise federal and state accountability requirements so that they treat each unit or department as a community on all possible measures.
- Provide funding to departments as a whole, when they have a significant number of productive faculty

It is unpopular in today's world to talk about visions and advocacy of visions. But if you have the vision and if you can articulate it, the rest of what you want will occur. In today's world, if you don't have it and can't articulate it, it will be a gradual decline.

members, to increase the efficiency of administration and to bolster a sense of community through local control.

Optional Joint Initiative

- Streamline and standardize the administration of research awards in order to free faculty time for undergraduate teaching, for community activities, and for nurturing the needs of an increasingly diverse student and faculty population.
- Reduce barriers to multidisciplinary research and teaching at both the institutional and the federal levels, to facilitate faculty ties across the campus community.

VI. Developing Relationships with New Partners in Research

Emerging relationships between university scientists and partners in industry or in federal laboratories present important opportunities for generating new research activities and for sharing facilities or other resources. These opportunities also generate new dilemmas in accomplishing institutional objectives and in protecting academic values and culture. Some observers believe that an increasingly austere environment will result in a growing temptation for some schools to commit significant time and resources to the pursuit of potentially lucrative partnerships with industry. Those participants in the national meeting who were concerned with the potential for distortion of campus culture called on policy makers and federal agencies to recognize and affirm the unique role of universities—and of university research—in society and to clarify expectations pertaining to basic research and competitiveness. Others expressed concern about the tension created by expectations for greater interaction and collaboration across research sectors, juxtaposed with increasing public attention to potential conflicts of interest in federally sponsored research. Major concerns were expressed by academic participants about requirements in federal grants for partnering with industry and the inherent difficulties for the grant recipient in establishing such relationships.

Despite some disagreement about the appropriate degree of interaction between university and industry scientists, and about the nature of federal oversight in this domain, there is widespread agreement that extensive public debate is needed to clarify national objectives and resolve contradictions among federal expectations for academic partnerships with industry. Agency officials must work with leaders of academic institutions and of industry laboratories to establish guidelines in areas such as conflict of interest and intellectual property rights. More forums designed to enable leaders from government, universities, and industry to meet and discuss aspects of the research enterprise of interest to all three sectors also would be valuable. Federally sponsored workshops intended to facilitate collaboration between industry and university scientists might be another effective mechanism for stimulating collaboration across domains.

Optional Responses for Academic Institutions

- Improve the processes of technology transfer from academia to industry and government, and create clear policies and procedures for managing intellectual property of commercial value.
- Develop closer communication and cooperation with both industrial organizations and federal laboratories, as well as programs for exchanging personnel.

Optional Responses for Government Agencies

- Establish programs to recycle supplies or equipment from federal laboratories to universities and to share unique or expensive state-of-the-art equipment with university researchers.

The research enterprise was once an elite function; today, it is a popular discussion. Every single elected official feels a stake in this, and they are right to feel a stake in it, because the pubic itself has higher and higher expectations of what science can do in the service of society.

• Establish a permanent R&D tax credit to encourage greater support by industry of university research.

• Apply federal funds freed up from the weapons labs to support civilian laboratories and universities, and create a clearinghouse on partnerships and international cooperation.

• Establish a coalition of industries and universities patterned on the now discontinued CORETECH to communicate with federal agencies about research priorities.

Optional Joint Initiatives

• Create new research enterprises—super affiliates programs—off campus to work in joint support of research, graduate teaching, and shared facilities.

• Work cooperatively to develop an international science policy.

CROSS-CUTTING CONCERNS AND FUNDAMENTAL CHALLENGES

Deliberations during the national meeting and the many campus-based discussions that preceded it identified an array of impediments to the effective functioning of academic institutions and investigators. These deliberations also revealed a rich variety of actions that the institutions and their sponsoring agencies might undertake to eradicate much of the stress and frustration experienced on university campuses. In addition, dialogue during the national symposium revealed an overarching concern about the deterioration of the basic compact that has united the federal government and universities since it was articulated originally by Vannevar Bush. A new compact governing the role of academic research in our society must be formulated, reflecting the broad changes that have transpired in the national and international climate within which universities function. It must make clear the roles and expectations of the university system within a broader national science policy.

Throughout the discussion between academic and federal participants at the national symposium, invited speakers and members of the audience alike called on university representatives to adapt their activities to national objectives and to couch presentations of their research in terms of national missions. Whether their concern was research or teaching, commentators suggested repeatedly that the rationale for much of the public's support of academic science and engineering has become tied to outcome measures pertaining to national goals. In the realm of research, especially, comments suggested waning support for pure, "curiosity-driven" research. There was broad-based sentiment that the compact articulated by Vannevar Bush, which bound federal sponsors to academic research recipients and which defined colleges and universities as the bastions of basic research "performed without thought of practical ends" may be too limited in today's world and should be reassessed.

In the boldest statement of the need for a new compact between science and society, some senior federal officials argued that academic participants failed to appreciate the deeper challenge before them, a challenge that goes to the very mission and to the way of doing business on university campuses. In her keynote address, for example, Under Secretary for Technology at the Department of Commerce Dr. Mary Good argued forcefully that "the status quo is not going to be maintained," and she urged the academic audience to "get out there with a vision of the future, not a justification of the past." According to Good, the nation needs "some statesmanlike leadership . . . to begin to articulate what the real, appropriate role of the university is in today's society, and where we wish to be in the 21st century."

Currently, there is considerable distrust by each party of the other's good faith, and doubt regarding the extent of constructive planning. There is a need to recreate a sense of partnership, trust, and shared vision among government, universities, and industry about what we as a nation wish to accomplish.

In invited remarks and in spontaneous observations from the audience, many of those present urged universities to address the new world in which they function. Several prominent participants emphasized the many changes occurring in the marketplace and among the consumers of university services. Reminding the audience that the end of the Cold War has reduced the government's reliance on research relevant to national security, Dr. M.R.C. Greenwood, Associate Director of the President's Office of Science and Technology Policy, pointed out that the focus of federal investments has shifted to research relevant to job creation and economic competitiveness.

Simultaneous with this shift in the focus of federal

support has been an increase in the proportion of nonfederal contributions to total funding of R&D. Raymond Sawyer, chairman of the Ohio Board of Regents, pointed out that state governments have increased their support for academic institutions, reflecting recognition of the importance of universities as economic engines. Texas State Representative Steve Ogden commented that the most persuasive appeal to state legislators for funding higher education is "a chamber of commerce type of argument"; in the context of a flat economy, he suggested, economic development is sometimes reduced to getting a new prison or building a four-year college in the community. Industry too, like state government, has become a more significant supporter of university research, with an interest in access to new talent and to faculty consultants.

Concurrent with these changes in the patronage of university research—and with the diversification of stakeholders in this enterprise—has been a "cultural shift" that places a premium on education and on training of relevance to the workplace. As the economy has moved away from traditional manufacturing industries, higher education has become more important to attaining well-paying jobs. One result of this development has been increasing pressure on universities to respond to the vocational needs of the student population. Several of the federal officials urged their university partners to move beyond traditional models built around the education of an elite class of scholars, and to acknowledge the public's demand that college education be a direct investment in future employment and earning capacity. Dr. Good, for example, suggested that universities are a service industry and cautioned the academic audience that if "the service that you provide over time does not satisfy the customer, who is the public, then the customer won't pay."

On the first day of the national summary meeting, the academic participants indicated that a *process* for developing and communicating the priorities for federal investment in research is lacking. They asserted that the planning procedures of the sponsoring agencies were poorly advertised, vitiating the institutions' ability to influence policy and funding decisions. On the second day, it became apparent that many of the federal officials responsible for making those decisions were unaware, too, of efforts by various institutions to accommodate particular federal appeals. To the surprise of all, there were indications throughout the day of more responsiveness on both sides of the research partnership than many observers assume, with growing coordination at the federal level and substantial openness to innovation among the university community.

To remedy this deficit of understanding and coordination, new mechanisms must be devised to ensure continuing communication among all stakeholders in the academic enterprise. Such communication will be essential to restore trust and a sense of partnership among all those interested in the success of our university system. Underscoring the urgent need for such communication, Dr. Neal Lane, Director of the National Science Foundation, espoused the value of a continuing colloquia, or some national forum, where representatives of federal and state governments, universities, industry, and other sectors could gather to discuss issues of mutual interest. Adding to the chorus in support of more clear and complete communication, Chairman Celeste called on both government agencies and universities to make explicit the many expectations that have remained implicit, including the assumptions and criteria each invokes concerning funding priorities and expectations about the contributions of university research to national goals.

NEXT STEPS

This project generated valuable experience and insights on a number of key issues of concern to both universities and external sponsors, especially the federal government. These issues include strategic planning, communication, balance between research and education, interdisciplinary science and engineering, the challenge of rebuilding a sense of community on campus, and the role of external partners and sponsors in the university environment. Within each of these areas, a number of possible, specific actions were identified for both government and universities.

To achieve maximum value from the insights acquired through this project, some additional activities need to be considered.

- First, the cosponsors of this project will explore the feasibility and the means for encouraging continua-

It is an extraordinarily exciting time. The issue is what role the United States is going to play in the next century. It is that straightforward.

tion and expansion of campus-based dialogues on stresses and remedies. Indications from the university participants in this project were that such discussions, involving members of both faculty and administration, had been beneficial and should be encouraged at additional sites.

- Second, there is need for a national forum that would bring together university and government representatives on a regular basis to review activities and progress on specific policies, programs, and strategies. The NSB and the Research Roundtable will explore opportunities to accomplish this objective.
- Third, pilot projects addressing one or more of the issues raised in this inquiry could be supported by appropriate funding agencies, in response to competitive proposals.

The insights gained through the campus discussions and the national symposium suggest that universities have both the opportunity and the capability to improve from within. Academic cultures and systems are slow to change. The directions suggested here, however, not only are needed, but also reinforce the fundamental academic values of collegiality, innovation, and integration of teaching and research. Many universities will find it helpful to approach these challenges not only through activities based on their own campuses, but through alliances with other institutions.

The insights garnered here suggest also that the federal government needs to assess its relationship with universities, articulating emerging requirements of a dramatically altered environment for higher education and research. As this country evaluates its science and technology policies at the cusp of two eras, there is an opportunity to define new terms for federal support of academic research and to influence new terms for state and industrial support of the same. By establishing new channels of communication on issues of policy and strategy, the federal government can tap into and synthesize the experiences and ideas of our great university system. Through the process of recasting its partnership with universities, and by establishing the basis for periodic reassessment and renewal of this agreement, the federal government can reaffirm its role as a catalyst for synergy between national needs and objectives and the scientific enterprise entrusted to our colleges and universities.

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PARTICIPATING INSTITUTIONS AND PROJECT CONTACTS

Oregon State University

John V. Byrne, President
George Keller,* Vice President for Research and Graduate Studies and International Programs

Pomona College

Peter W. Stanley, President
Gary Reiness,* Associate Dean of Faculty

Stanford University

Gerhard Casper, President
Charles Kruger, Vice Provost and Dean of Research and Graduate Policy
Patricia Devaney,* Associate Dean of Research

U C L A

Charles Young, Chancellor
Kumar Patel,* Vice Chancellor for Research

University of Arizona

Manuel T. Pancheco, President
Charles A. Geoffrion,* Associate Vice President for Research and Director of Research Communication
Michael Cusanovich, Vice President for Research and Graduate Studies

Case Western Reserve University

Agnar Pytte, President
Janie Fouke,* Associate Professor of Biomedical Engineering

Texas A&M University

E. Dean Gage, Interim President
Robert Kennedy,* Vice President for Research and Associate Provost for Graduate Studies

University of Wisconsin, Madison

David Ward, Chancellor
John D.Wiley,* Dean, The Graduate School

Florida State University

Robert Glidden, President
Joseph E. Lannutti,* Associate Vice President for Research

Howard University

Franklyn Jenifer, President
O. Jackson Cole,* Associate Vice President for Research Administration

Lehigh University

Peter Likins, President
Sunder Advani, Dean of Engineering and Applied Sciences
Gary DeLeo,* Professor, Physics Department

North Carolina State University

Larry K. Montieth, Chancellor
James Moyer,* Professor, Department of Plant Pathology

Yale University

Richard Levin, President
Judith Rodin, Provost
Robert Szczarba,* Deputy Provost for Physical Sciences and Engineering

Guidance Group

Theodore Brown, Interim Vice Chancellor for Academic Affairs, University of Illinois
Richard F. Celeste, Chairman, Government-University-Industry Research Roundtable
Roland Schmitt, Member, National Science Board
Max Summers, Distinguished Professor, Texas A&M University
Robert Zemsky, Professor, University of Pennsylvania

*Indicates primary contact and project coordinator

CONFERENCE PROGRAM

December 7–8, 1993
National Academy of Sciences
Washington, D.C.

Day I *Working Session: Academic Participants*

1:00 WELCOME
Richard Celeste, Roland Schmitt

1:30 COMMENTS ON PROCESS AND OBJECTIVES
Marta Cehelsky, Don Phillips

1:45 DISCUSSION OF PROJECT ISSUES
(University Representatives)
- Q1: Identifying Priorities
- Q2: Balancing Research and Education
- Q3: Interdisciplinary Research and Education

3:15 BREAK

3:30 CONTINUED DISCUSSION OF PROJECT ISSUES
- Q4: Patterns of Institutional Support
- Q5: Restoring a Sense of Community
- Q6: Fostering New Relationships

5:00 SUMMARY OF BROAD THEMES
The Guidance Group

5:30 ADJOURN

Day II *Working Session: Academic Participants and Federal Agency Representatives*

9:00 WELCOME AND INTRODUCTION
Richard Celeste, Roland Schmitt

9:10 REMARKS ON NATIONAL CONTEXT AND PRIORITIES FOR RESEARCH COLLEGES AND UNIVERSITIES

Dr. M.R.C. Greenwood
Associate Director for Science
Office of Science and Technology Policy
Executive Office of the President

The Honorable Steve Ogden
Texas State House of Representatives

9:40 PRESENTATION OF ACTION AGENDAS
(University Representatives)

10:10 OPEN DISCUSSION, FEDERAL COMMENT
(Celeste, moderator)

12:00 BREAK FOR LUNCH

Plenary Session

1:00 OPENING REMARKS
Richard Celeste

1:05 NATIONAL OVERVIEW: PRIORITIES AND PRESSURES ON ACADEMIC INSTITUTIONS

Dr. Mary L. Good
Under Secretary for Technology
U.S. Department of Commerce

1:20 STATE PERSPECTIVE: WORKING EFFECTIVELY WITH STATE PARTNERS

Raymond T. Sawyer, Esq.
Chairman
Ohio Board of Regents

1:30 IMPETUS AND OBJECTIVES FOR THE NSB/ROUNDTABLE STUDY: FOCUS ON ACTION
Roland Schmitt

1:40 PRESENTATION OF ACTION AGENDAS
(University Representatives)

2:10 OPEN DISCUSSION
(Celeste, Moderator)

3:00 ADJOURN